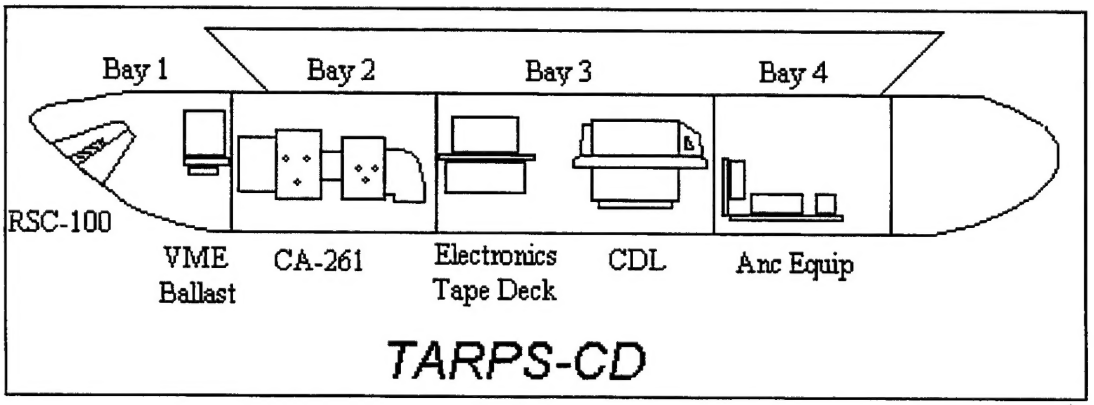
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
PATUXENT RIVER, MARYLAND

STRUCTURAL TEST/ANALYSIS REPORT

REPORT NO: NAWCADPAX--99-7-SAR

STRUCTURAL INVESTIGATION OF THE F-14 TARPS CD POD

7 January 1999



DEPARTMENT OF THE NAVY
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
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This report presents the results of a structural evaluation of the Tactical Air Reconnaissance Pod System (TARPS) completely digital (CD) pod for demonstration flights on the F-14 aircraft. Based upon evaluation presented in this report, recommend the TARPS CD pod be authorized for flight test to the current F-14 NATOPS limits when configured with a standard TARPS pod, including carrier suitability operations.

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6 Jan 1999

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7 Jan 1999

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13. ABSTRACT *(Maximum 200 words)*

This report presents the results of a structural evaluation of the Tactical Air Reconnaissance Pod System (TARPS) completely digital (CD) pod for demonstration flights on the F-14 aircraft. Based upon evaluation presented in this report, recommend the TARPS CD pod be authorized for flight test to the current F-14 NATOPS limits when configured with a standard TARPS pod, including carrier suitability operations.

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INTRODUCTION

BACKGROUND

1. The Naval Research Laboratory (NRL) was tasked to evaluate the feasibility of a completely digital (CD) reconnaissance system. The platforms selected for this effort were the Tactical Air Reconnaissance Pod System (TARPS) primary structure, to house the system, and the F-14 aircraft, to carry the pod. Platform Systems, Incorporated, (PSI) was contracted by NRL to design the mechanical and electrical interface between the aircraft, pod, and system components. PSI also performed the structural analyses of the pod and internal system, in accordance with guidelines established during a meeting between PSI, Air Vehicle/Stores Compatibility (AVSC) Division (4.11.2), and Tactical Aircraft Strength Branch (4.3.3.1). NRL tasked Test Article Preparation Division (5.4) to fabricate all of the structural components designed by PSI. Under reference 1, NRL tasked AVSC Division to review PSI's structural analyses, and provide reports to PSI and Tactical Aircraft Strength Branch, with flight clearance recommendations.

DESCRIPTION OF AIRCRAFT AND TARPS CD SYSTEM

F-14 AIRCRAFT

2. Refer to the applicable NATOPS and TACMAN for information on the F-14 aircraft.

TARPS POD SHELL

3. The TARPS pod shell is a 22 in. approximate diameter metal structure, consisting primarily of aerospace grade aluminum alloys, with a skin/rib/bulkhead design. Reference 2 contains detailed information on the TARPS pod.

TARPS CD SYSTEM COMPONENTS

4. The TARPS CD system components consist of the "major" components as shown in figure 1. In order to install the CD components into the TARPS pod shell, custom mounting hardware was designed and fabricated.

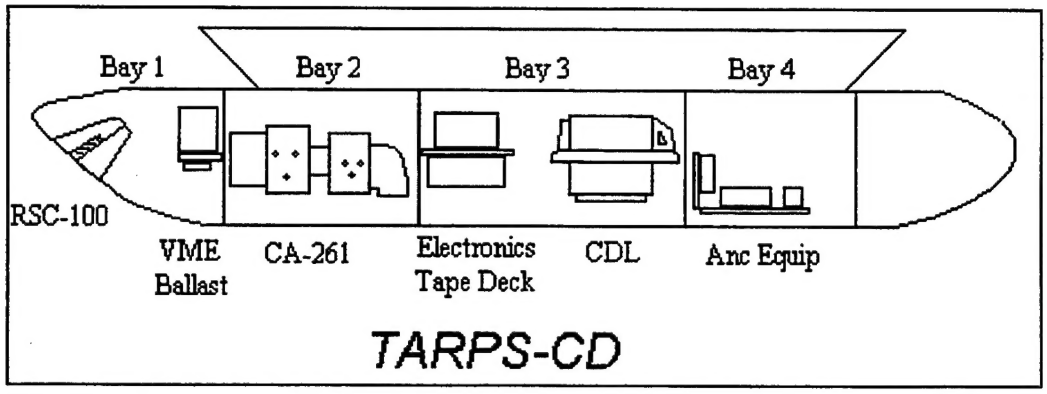

Figure 1
TARPS CD SYSTEM COMPONENTS AND LAYOUT

RSC-100 CAMERA AND MOUNTING HARDWARE – BAY 1

5. The RSC-100 camera alone is 1 in. x 1.4 in. x 4.7 in. in size and weighs 5 oz. The camera is attached using two No. 20 screws in locking helical inserts in the camera body. The camera is bolted to a mounting assembly consisting of a formed mounting plate, PSI drawing 1647; a bracket, PSI drawing 1679; and two gussets, PSI drawing 1680. The formed mount plate and the bracket are made of 0.090 in. thick 6061-T6 aluminum, and the gussets are made of 0.060 in. thick aluminum. The mounting assembly forms a rigid structure in all directions, and has no portion of its structure which is considered critical for this application. The assembly attaches to the TARPS CD pod using eight No. 10 screws. The screw locations are at the TARPS CD pod nose window frame. The entire assembly mass is under 10 lb, and is attached using eight No. 10 screws. The Sekai RSC-100 camera technical information is contained in reference 2. PSI drawings of the RSC-100 mounting hardware is presented in reference 3.

VME AND BALLAST AND MOUNTING HARDWARE – BAY 1

6. The TARPS CD system includes a VME package and ballast mounted in the TARPS CD pod Bay 1, attached to the station 45 and station 55 bulkhead. The VME/ballast installation hardware consists of ~20 components, the VME, and lead ballast. The VME weighs 25 lb and is 13 in. x 10 in. x 12 in. The lead ballast weighs 125 lb and is 8.5 in. x 10.5 in. x 3.75 in. The VME and ballast are bolted to a mounting assembly consisting of a 0.190 in. thick aluminum mounting plate, PSI drawing 1746A; two 0.090-in. thick aluminum channel brackets, PSI drawings 1770 and 1771; and two 0.125-in. thick aluminum vertical channels, PSI drawings 1767 and 1753A. The mounting assembly forms a rigid structure in all directions, and has no portion of its structure which is considered critical for this application. The assembly attaches to the TARPS CD pod station 55 bulkhead using five 1/4-in. fasteners and two 3/8-in. fasteners. The assembly also attaches to the TARPS CD station 45 bulkhead using two 1/4-in. bolts. The VME and ballast, and their mounting hardware information is contained in reference 4.

CA 261 CAMERA AND MOUNTING HARDWARE – BAY 2

7. The CA-261 consists of two major components, the CA-260 (which is the KS-87 camera and the ISU which have flown as a unit before in the F-14 TARPS pod), and the stepping/pointing unit, which is attached to the CA-260 and also has its own mounting hardpoints. The CA-261 is 18 in. high, 41 in. long, 16 in. deep in size, and weighs 148 lb including the power supply. The CA-261 is attached using 12 1/4-in. threaded inserts. The CA-261 is bolted to two machined mounting plates (one per side), PSI drawing 1693. The CA-261 camera and its mounting hardware information is contained in reference 5.

AMPEX TAPE DECK AND ELECTRONICS BOX – BAY 3

8. The Ampex tape deck and electronics box mount at the TARPS CD pod Bay 3, attaching to the original TARPS pod bay 3 forward mounting hardpoints, and additionally to the bay 3 forward bulkhead. The tapedeck, electronics box, and mounting assembly consist of approximately 30 components (not including fastener components), which provide a vibration isolated interface between the tapedeck/electronics box and the pod structure. The tapedeck is ~12 in. wide, 8 in. high, 18 in. long in size and weighs 33 lb, and is mounted using four 1/4-in. bolts. The electronics box is ~12 in. wide, 8 in. high, 18 in. long, and is attached using four 1/4-in. bolts. The tapedeck is mounted on plates that can pivot at the forward end, allowing quick access to the tape. The aft end of the pivoting assembly is restrained using two 1/4-in. bolts when the tapedeck is stowed. The Ampex tape deck and electronics box and their mounting hardware information is contained in reference 6.

CDL – BAY 3

9. The CDL equipment consists of three main components. The Airborne Modem assembly is 14 in. x 10 in. x 8.5 in. in size and weighs 39 lb. The radio frequency assembly is 15 in. x 10 in. x 8 in. in size and weighs 24.5 lb. The Power Control Unit is 12 in. x 12 in. x 4.5 in. in size and weighs 20 lb. The CDL equipment and CDL equipment mounting hardware information is contained in reference 7.

CDL ANTENNA INSTALLATION – BAY 3

10. The CDL antenna installation includes the transmitting antenna, and custom designed and fabricated mounting hardware (approximately 9 major components). The antenna is located externally on the underside of the Bay 3 access panel, towards the aft end. The CDL antenna is 8 in. x 5 in. x 5 in. in size and has negligible mass. The CDL antenna is attached using eight No. 10 screws. The CDL antenna is attached to a mounting plate made out of 0.125 in. thick 6061-T6 aluminum, PSI drawing 1720. In addition to the mounting plate, there is a doubler plate made of 0.60 in. thick 6061-T6 aluminum which is attached to the mounting plate via three 0.060-in. thick formers. The assembly attaches to the TARPS CD pod using two formed 0.190 in. thick aluminum plates, which run longitudinally along either side of the main 0.125 in. thick mounting plate. The CDL antenna equipment and CDL antenna equipment mounting hardware information is contained in reference 8.

CD ANCILLARY EQUIPMENT – BAY 4

11. The CD ancillary equipment includes a power converter, two video tape recorders, a ruggedized computer and an electronics junction box. The MS27209 power supply is 9 in. x 5.25 in. x 5.5 in. in size and weighs 10 lb. Each video recorder weighs 7 lb and is 6 in. x 5 in. x 7 in. in size. The electronics junction box is 11 in. x 10 in. x 4 in. in size and weighs 6 lb. The PC104 ruggedized computer is 14.4 in. x 5.5 in. x 7.5 in. and weighs 11 lb. The ancillary equipment is attached to a mounting plate of 0.19 in. thick 6061-T6 aluminum, PSI drawing 1781. In addition to the mounting plate, there is a partial doubler plate made of 0.50 in. thick 6061-T6 aluminum which serves as a spacer also on the underside of the main 0.190 in. plate. Detailed information on the ancillary equipment and ancillary equipment mounting hardware is detailed in reference 9.

METHOD OF ANALYSIS/EVALUATION

12. PSI conducted the original analysis of the installation of each of the TARPS CD components installed in the TARPS pod. All major portions of the analysis were conducted using the classical method. Structural engineers from the AVSC Division (4.11.2), reviewed the PSI analyses and inspected/evaluated the actual TARPS CD components and their installation. References 3 through 9 are the AVSC reports documenting the results of these reviews. NAVAIRSYSCOM tasked Ronkokaman Aerospace Technologies, Incorporated, (RAT, Inc.) to evaluate references 3 through 9.

RESULTS OF ANALYSIS AND REVIEW

13. References 3 through 9 all reported that the components and their installations for the TARPS CD system were structurally satisfactory for flight test to the current F-14 NATOPS limits when configured with a standard TARPS pod, including CVS operations. Reference 10 is the RAT, Inc., initial report following review of references 3 through 9. Reference 10 questioned technical portions of several of the references, but also noted that overall, the judgment was that the TARPS CD system was structurally satisfactory for flight test. Reference 11 is an AVSC response to reference 10, which addressed all concerns of reference 10. Note that reference 11 contains a response from PSI also. Based upon reference 11, RAT, Inc., released reference 12, which concluded that the TARPS CD system was structurally satisfactory for flight test.

CONCLUSION

14. The TARPS CD pod is satisfactory for flight test to the current F-14 NATOPS limits when configured with a standard TARPS pod, including CVS operations.

RECOMMENDATION

15. Recommend the TARPS CD pod be authorized for flight test to the current F-14 NATOPS limits when configured with a standard TARPS pod, including CVS operations.

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REFERENCES

1. Work Order, N00173-98-WR-00190, "Analysis of Safety of Flight for TARPS Pod", of 29 Jan 1998.

2. NAVAIR 10-1TARPS-2-3, "Tactical Air Reconnaissance Pod Maintenance LA-610A", Change 2 of 1 Feb 1992.

3. NAWCAD Patuxent River Air Vehicles/Stores Compatibility Report No. ORD-4R-98, "Structural Investigation of the RSC-100 Camera Installation in the F-14 TARPS CD Pod", of 11 Sep 1998.

4. NAWCAD Patuxent River Air Vehicles/Stores Compatibility Report No. ORD-5R-98, "Structural Investigation of the VME and Ballast Installation in the F-14 TARPS CD Pod Bay 1", of 11 Sep 1998.

5. NAWCAD Patuxent River Air Vehicles/Stores Compatibility Report No. ORD-6R-98, "Structural Investigation of the CA-261 Camera and Installation in the F-14 TARPS CD Pod Bay 2", of 14 Sep 1998.

6. NAWCAD Patuxent River Air Vehicles/Stores Compatibility Report No. ORD-8R-98, "Structural Investigation of the Ampex Tape Deck and Electronics Box Installation in the Forward End of the F-14 TARPS CD Pod Bay 3", of 16 Sep 1998.

7. NAWCAD Patuxent River Air Vehicles/Stores Compatibility Report No. ORD-9R-98, "Structural Investigation of the CDL Installation in the Aft End of the F-14 TARPS CD Pod Bay 3", of 22 Sep 1998.

8. NAWCAD Patuxent River Air Vehicles/Stores Compatibility Report No. ORD-10R-98, "Structural Investigation of the CD Ancillary Equipment Installation in the F-14 TARPS CD Pod Bay 4", of 25 Sep 1998.

9. NAWCAD Patuxent River Air Vehicles/Stores Compatibility Report No. ORD-11R-98, "Structural Investigation of the CDL Antenna Installation on the F-14 TARPS CD Pod", of 30 Sep 1998.

10. Ronkokaman Aerospace Technologies, Incorporated, Letter, "TARPS CD, Evaluation of Structural Analysis in Support of Flight Certification for Demonstration Flights", of 8 Jul 1998.

11. NAWCAD Patuxent River Air Vehicles/Stores Compatibility Report No. ORD-12R-98, "Response to RAT, Inc. Report 98-002", of 30 Jul 1998.

12. Ronkokaman Aerospace Technologies, Incorporated, letter, "TARPS CD, Evaluation of Structural Analysis in Support of Flight Certification for Demonstration Flights", of 19 Aug 1998.

APPENDIX A
RONKOKAMAN AEROSPACE TECHNOLOGIES, INCORPORATED, LETTER *"TARPS CD, EVALUATION OF STRUCTURAL ANALYSIS IN SUPPORT OF FLIGHT CERTIFICATION FOR DEMONSTRATIONS FLIGHTS"*

COPY

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e-mail: krdconsult@aol.com

August 19, 1998

Rick Ryan
NAVAIR 4.3.3

Subject: TARPS CD, Evaluation of Structural Analysis in Support of Flight Certification for Demonstration Flights.

References:

1. Ronkonkoma Aerospace Technologies, Inc. Report No. RAT 98-002, July 8, 1998
2. E-mail from Jack Pratt, Report No. ORD-01R-94, "Response to RAT, Inc. Report 98-002", July 30, 1998
3. Fax from Eric Yankovich, "Response to RAT, Inc. TARPS Stress Analysis Comments", July 21, 1998

Dear Rick,

Eric Yankovich and Jack Pratt have provided references 2 and 3 to address the comments of reference 1. On the basis of this information, telecons with Eric Yankovich and my additional analyses, I feel that the three contentious items of reference 1 have been resolved.

The table below summarizes those items and provides an explanation of how they were resolved.

Sub-Assembly	Comments - RAT 98-002	Resolution
Bay 1 VME and Ballast Installation	Bending of the 1746 mounting plate is excessive.	RAT re-analysis of support structure, taking into account all load paths supports the original analysis and margins of safety.

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Bay 2 CA261 Installation	Acceptable with some relief on G levels.	Limited strength latches have been replaced.
Bay 3 Tape Deck Installation	Unacceptable - see comments below.	Finite element analyses of flanges shows that the equivalent bending width is as stated in the original analyses provided.

Page 3 of Reference 2 identifies items relating to existing TARPS primary structure which were previously discussed with, and agreed to by AIR 4.3.3. In the event that these comments are satisfactory to you, then my conclusion is that the installation is acceptable and airworthy for the demonstration program.

Sincerely yours,

Paul Bell

cc:
Jack Pratt
Eric Yankovich

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